GRACE Follow-On Mission Status

M. Watkins (JPL),
M. Gross (JPL), B. Tapley (UTCSR), S. Bettadpur (UTCSR),
And our German Colleagues:
F. Flechtner, B. Doll, J. Munder, C. Reigber, and J.-C Raimondo

JPL

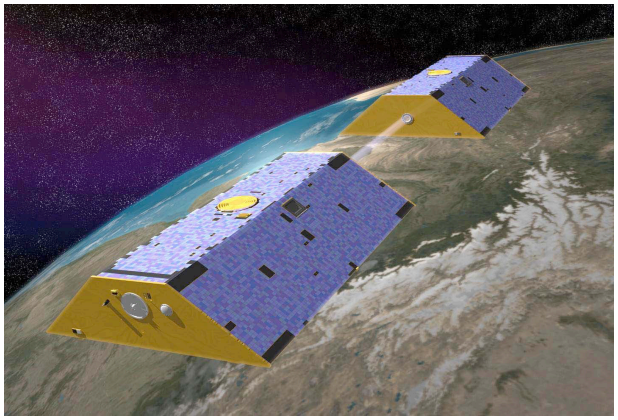
Outline

- The science rationale for GRACE Follow-On mission
- Recent programmatic developments
- The technical approach to GRACE Follow-On mission

GRACE Mission Status

Mission Status

- Gravity Model Release
  - RL4 Mean field(GGM03C and Eigen-GL 05C)
  - Time Variable Signals(100 monthly solutions through Sep 10)
  - Multidisciplinary science results are demonstrating importance of " global mass flux measurements"
- NASA 2009 Senior Review Completed
- NASA/DLR MOU Renewed



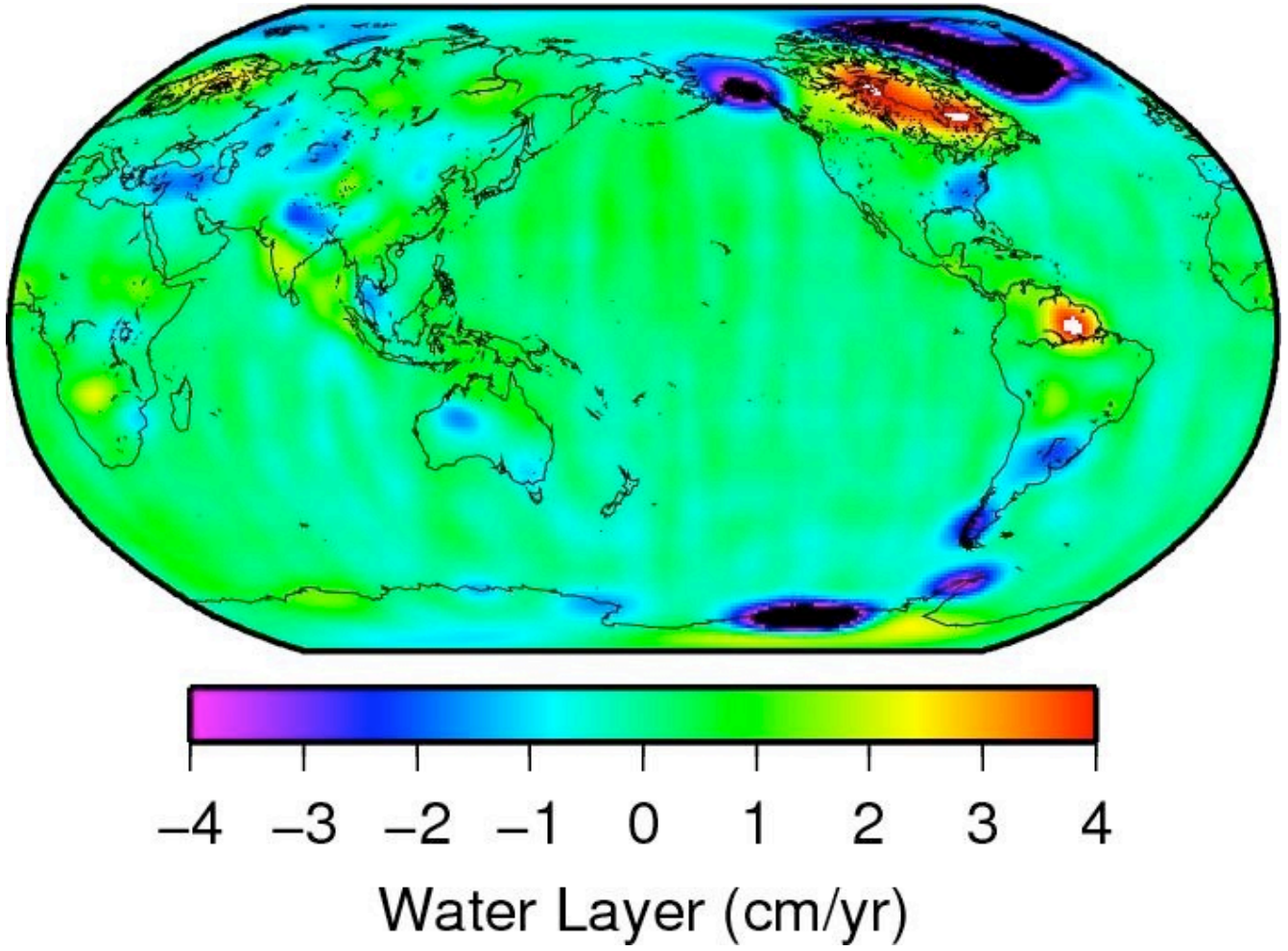
Flight Segment

- Nearly 100 % of scientific measurements during 8.5 yrs have been collected and analyzed
- Certain sub-systems are single-string on both s/c
- New thermal regimes to conserve battery
- Instrument performance meeting mission requirements

Orbit and Satellites

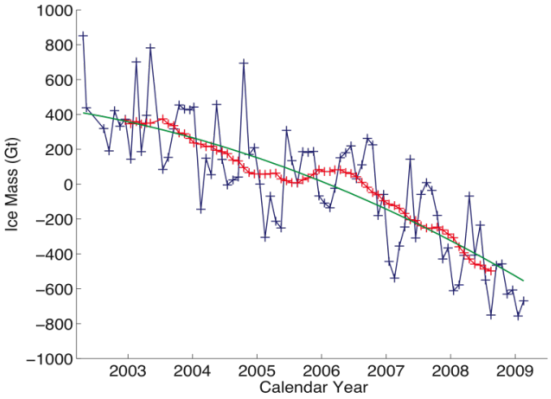
Launched: March 17, 2002
Over 8 years in orbit
Initial Altitude: 500 km
Current Altitude: ~460 km
Inclination: 89 deg
Eccentricity: ~0.001
Separation Distance: ~220 km
Currently 220 km
Nominal Mission : 5 years
Non-Repeat Ground Track, Earth Pointed, 3-Axis Stable
Predicted Lifetime 2013-15(?)

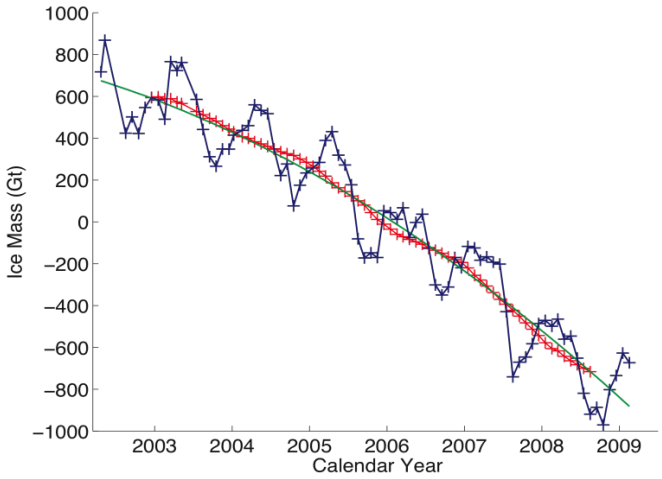
Trends Estimated from GRACE 2002-2009



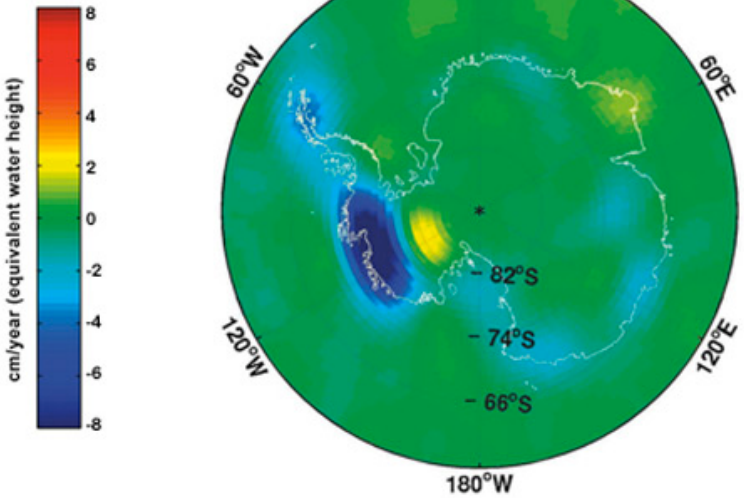
Images of GRACE trends show several influences of inter-annual variability

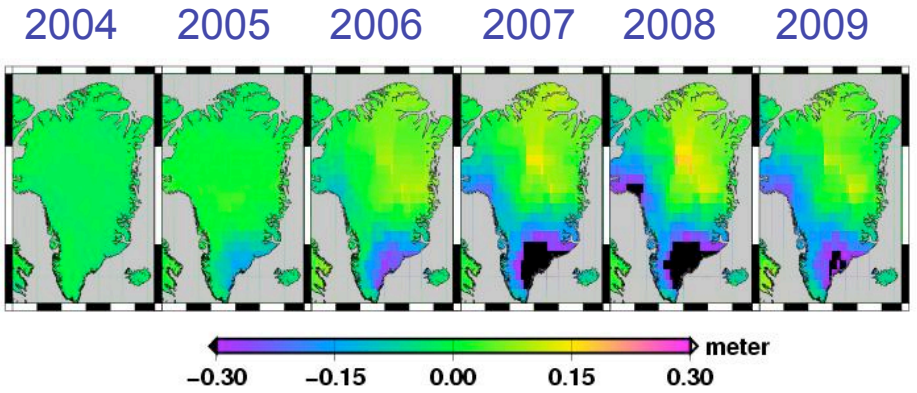
Variability in Ice-Mass Change





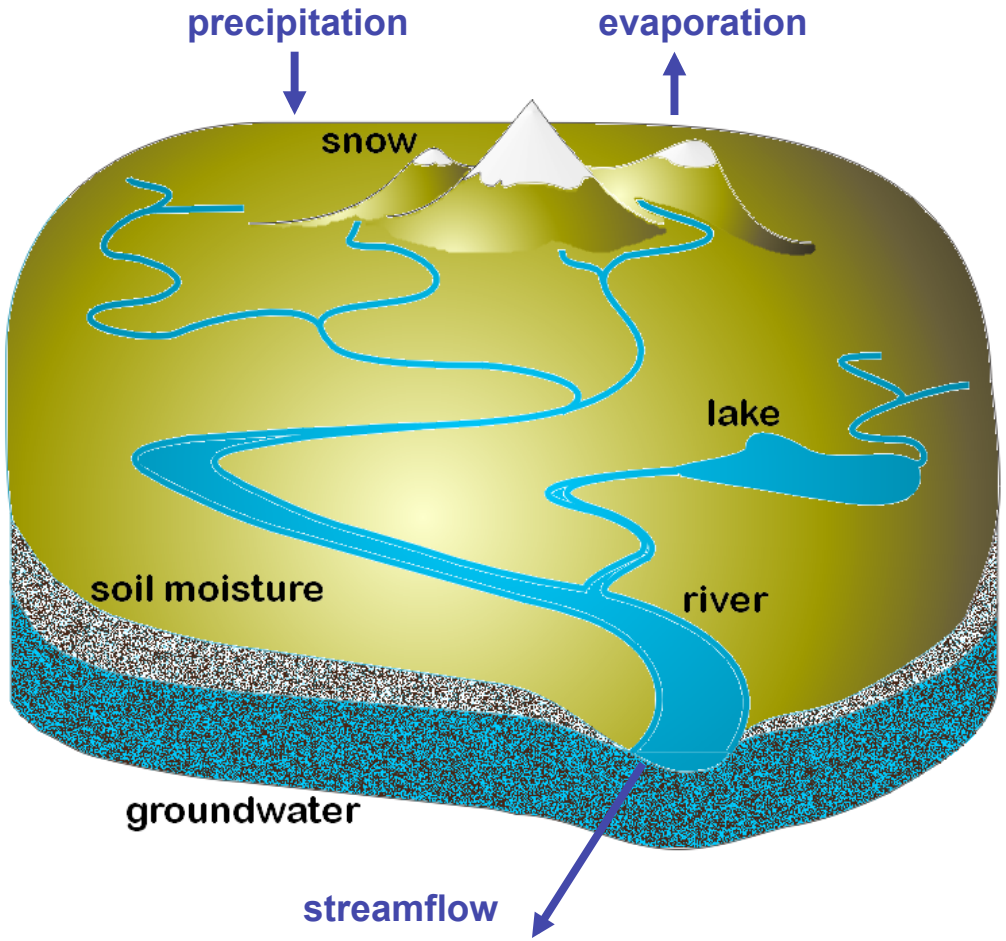
(from Velicogna et al, 2009)





From Watkins et al, 2009

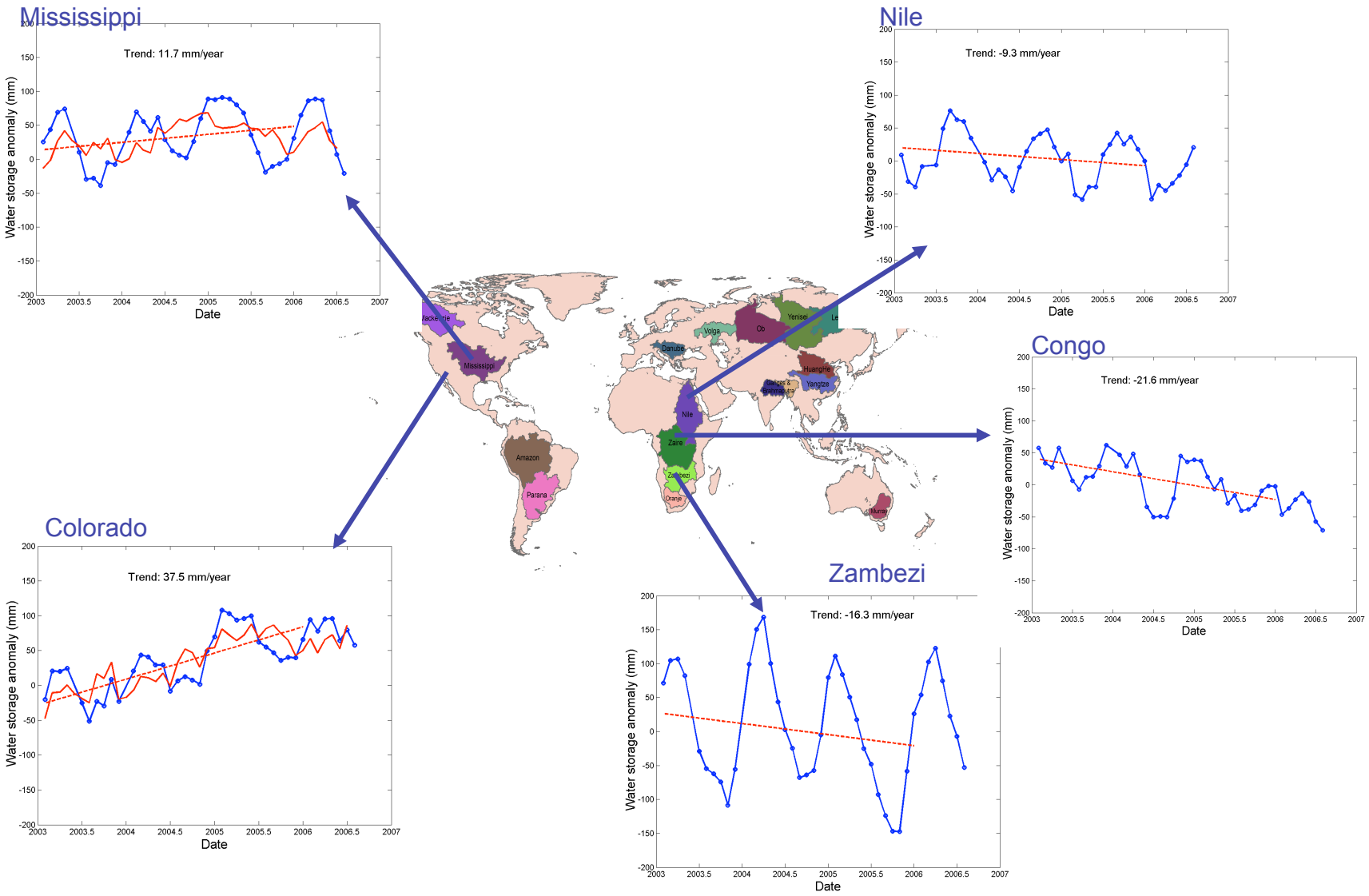
How GRACE really "sees" water balance



- GRACE measures the change in all of the water stored on land after precipitation has been stored as snow, infiltrated into the ground, evaporated, or left the basin as streamflow
- Accounting for these inflows, outflows and storage changes is called **water balance**

Storage Change = Inflows (Precipitation) - Outflows (Evaporation + Streamflow)

GRACE is tracking water storage in large river basins



Broad Acceptance of Science Justification

- There is broad scientific consensus about the high value of GRACE measurements of mass flux, including the manifestations of critical climate change processes at long time-scales.
  - Ice sheet mass trends
  - Regional water storage variability and trends
  - Ocean mass trends and their impact on sea-level rise

- GRACE has measured regional patterns of mass flux variability in a globally consistent manner.
  - Long duration GRACE observations will help in discriminating regional patterns of mass flux resulting from (decadal time-scale) climate teleconnections and from anthropogenic contributions.

GRACE Follow-On Status: 2007-2010

- NASA had accepted GRACE-II as a Decadal Survey mission, but the launch date (~>2020) would create a significant gap in this critical climate dataset
  - Similar gap would result from the nominal ESA plans
- GRACE Follow-On studies were split into two (sequential) parts
  - Quick gap-filling GRACE for launch ~2015
  - Longer term more capable/more satellites for launch >~2020 (not further discussed here)
- As of spring 2010, ***NASA has included the rapid follow-on to GRACE in its budget for a start in FY 2011, with launch by 2016***
  - This budget (like the overall NASA budget) is still subject to approval by the US Congress

GRACE Follow-On

- The GRACE Follow-On mission is heavily focused on maintaining data continuity from GRACE and minimizing any data gap after GRACE.

- The baseline is to therefore to maintain maximum heritage from GRACE, and to minimize project schedule, along with technical risk and cost risk
  - Significant technical and cost analysis was performed along this path in 2009-2010
  - NASA understands the value in carefully considering a technical demonstration of a laser interferometer system that could reduce risk for higher spatial resolution missions on the 2020+ time frame
    - Several ESTO Instrument Incubators to get system to TRL to 6 (JPL, Ball, CU, Hannover)
    - Subnanometer performance demonstrated
- NASA welcomes continuation of the highly successful GRACE partnership with DLR and GFZ